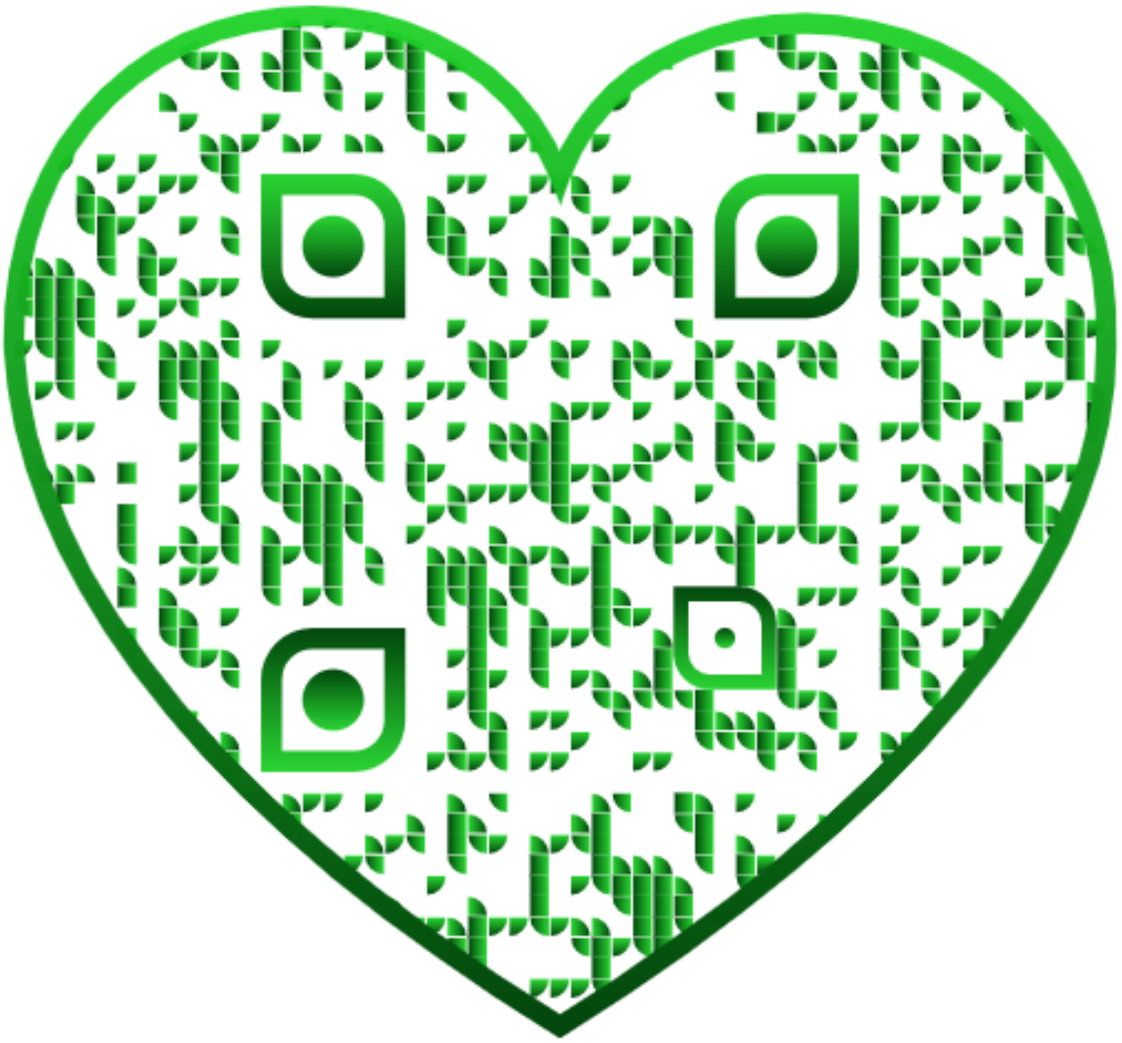
EXIT exam preparation for pharmacy graduating students



ANS pharmacology

- Cholinergic Receptor Activators
  - Direct activators: bethanechol (M), carbachol (M and N), nicotine (N),pilocarpine (M)
  - AChE inhibitors:
    - reversible—edrophonium, physostigmine, neostigmine, pyridostigmine
    - AChE inhibitors: irreversible—malathion, parathion
- Cholinergic Receptor Antagonists
  - Muscarinic blockers: atropine, benztropine, ipratropium, scopolamine
  - Ganglionic blockers: hexamethonium, mecamylamine

- Adrenergic Receptor Activators
  - Direct acting
    - α1 agonists: phenylephrine
    - α2 agonists: clonidine, methyldopa
    - β agonists: dobutamine (β1 > β2)
    - β2 agonists: albuterol, terbutaline, salmeterol
    - β3 agonist: mirabegron
    - Non selective: dopamine (D1, β1, α1), epinephrine (α1, α2, β1, β2), norepinephrine (α1, α2, β1)
  - Indirect-acting: amphetamine, cocaine, ephedrine, tyramine

- Adrenergic Receptor Antagonists
  - α1antagonists: doxazosin, prazosin, terazosin
  - α2 antagonists: mirtazapine
  - Mixed α antagonists: phenoxybenzamine, phentolamine
  - β1 (cardio selective) antagonists: acebutolol, atenolol, metoprolol
  - β1, β2 (nonselective): pindolol, propranolol, timolol
  - α1 and β antagonists: carvedilol, labetalol

Case 1

A 5-year-old child becomes ill while visiting relatives who have a farm in rural areas. His symptoms include severe abdominal cramps with vomiting and diarrhea and profuse lacrimation and salivation. Pupillary constriction is marked. The most likely cause of toxicity was exposure to organophosphates. How can you treat the child?

A. Treat the patient by giving activated charcoal
B. Treat the patient by giving high dose of atropine and low dose of pralidoxime
C. Treat the patient by giving low dose of atropine and high dose of pralidoxime
D. Use of oral cholestyramine to bind with Organophosphates

- ✓The most appropriate treatment for organophosphate toxicity in this scenario would be to treat the patient by giving a high dose of atropine and a low dose of pralidoxime.

- ✓Atropine is used to counteract the muscarinic effects of organophosphate poisoning, such as excessive lacrimation, salivation, and abdominal cramps. Pralidoxime is a cholinesterase reactivator that helps to restore the activity of acetylcholinesterase, which is inhibited by organophosphates.

- ✓Activated charcoal is not typically used in the treatment of organophosphate toxicity. Oral cholestyramine is not a standard treatment for organophosphate poisoning and would not address the underlying mechanism of toxicity.

- ✓**Therefore, the correct choice is to treat the patient by giving a high dose of atropine and a low dose of pralidoxime.**

Case 2

An 11-year-old boy was brought to the ER by some of his friends because he “started going crazy” after eating seeds from a plant while “trying to get high.” The boy was incoherent; his skin was hot and dry. His pupils were dilated and unresponsive to light. Blood pressure was 180/105 mm Hg, pulse 150/min, and rectal temp 40 oC. The presumptive diagnosis was drug toxicity due to the ingestion of a compound similar to

A. Cannabis

B. Digoxin

C. Nicotine

D. Scopolamine

- The symptoms described in the scenario, including incoherence, hot and dry skin, dilated and unresponsive pupils, elevated blood pressure, rapid pulse, and high fever, are consistent with anticholinergic toxicity.

- Therefore, the most likely compound ingested by the boy that caused his symptoms is similar to scopolamine. The correct answer is: **Scopolamine**

- **Scopolamine** is an anticholinergic drug that can cause these symptoms when ingested in high doses. It is commonly found in plants such as Datura and Brugmansia, which are sometimes mistaken for other plants or seeds and ingested for recreational purposes.

Case 3

A 40 years old male with generalized anxiety disorder controlled his anxiety with alprazolam. However, the patient starts to experience weakness, blurred vision, drowsiness, poor judgment, and asks his friends for their benzodiazepine pills. Which of the following is used to manage such conditions of the patient?

a. N-acetyl cysteine

b. **Flumazenil**

c. Deferoxamine

d. Protamine

Case 4

- A colleague with myasthenia gravis wants you to assist him to the ER because he is experiencing muscle weakness and has found it difficult to titrate his drug dosage because he has had the “flu.” You note that he has a slight temperature, shallow respirations, and a gray-blue skin pallor. What would be the most appropriate drug to give to your colleague at this time?
  A. Albuterol
  B. Edrophonium
  C. Physostigmine
  D. Scopolamine

- The symptoms described in the scenario, including muscle weakness, difficulty titrating drug dosage, slight temperature, shallow respirations, and gray-blue skin pallor are concerning for a myasthenic crisis in a patient with myasthenia gravis. Myasthenic crisis is a life-threatening condition characterized by severe muscle weakness that can lead to respiratory failure.
- **Therefore, the correct answer is: B. Edrophonium**
- Given the situation, the most appropriate drug to give to your colleague at this time would be edrophonium (Option B). Edrophonium is a short-acting acetylcholinesterase inhibitor that can help differentiate between myasthenic crisis and cholinergic crisis in patients with myasthenia gravis. By temporarily increasing acetylcholine levels at the neuromuscular junction, edrophonium can improve muscle strength in myasthenic crisis, helping to confirm the diagnosis and guide treatment.

Case 5

Carvedilol is an effective antihypertensive agent that, like propranolol, is capable of blocking beta receptors. An important difference between the two drugs is that carvedilol

A. is a selective blocker of cardiac β1 receptors

B. has intrinsic sympathomimetic activity

C. is available only as eye drops

D. has α1 receptor blocking actions

- **Carvedilol is a non-selective beta-blocker that also has alpha-1 receptor blocking actions**. This dual action makes carvedilol unique compared to propranolol, which is a non-selective beta-blocker without alpha-1 receptor blocking properties.
- The alpha-1 receptor blocking actions of carvedilol contribute to its vasodilator effects and can help lower blood pressure more effectively in certain populations, such as patients with heart failure.
- D. has α1 receptor blocking actions

Case 6

Following a myocardial infarct, a 40-year-old man is being treated prophylactically with propranolol. You would be concerned about the use of this drug if the patient also had what comorbid condition?

A. Diabetes

B. Glaucoma

C. Classic/stable angina

D. Supraventricular tachycardia

- Propranolol is a non-selective beta-blocker that blocks both beta-1 (β1) and beta-2 (β2) adrenergic receptors. When used in patients with glaucoma, there is a concern about its potential to exacerbate the condition. Beta-blockers can cause pupillary constriction and decrease the production of aqueous humor, leading to an increase in intraocular pressure.
- **This increase in intraocular pressure can worsen the symptoms of glaucoma and potentially lead to an acute angle-closure glaucoma crisis.**
- **B. Glaucoma**

Case 7

When injecting a dose of penicillin to a patient without prior skin test and if patient suddenly developed immediate hypersensitivity reactions. Which of the following should not be done for the patient?

A) Administer epinephrine, IM
B) Administer dopamine, IV infusion
C) Administer Chlorpheniramine, IM/IV
D) Administer Hydrocortisone, IV

- So, the correct answer is: B. Administer dopamine, IV infusion
- Dopamine is not indicated for the treatment of immediate hypersensitivity reactions like anaphylaxis.
- In this scenario, epinephrine is the drug of choice for the treatment of anaphylaxis as it acts quickly to reverse the symptoms of the allergic reaction.
- Chlorpheniramine is an antihistamine that can help relieve symptoms like itching and hives.
- Hydrocortisone is a corticosteroid that can help reduce inflammation and prevent late-phase allergic reactions.
- Therefore, administering dopamine, which is not indicated for anaphylaxis, would not be appropriate in this situation.

Case 8

- JN, a healthy 46-year-old, develops seasonal allergies. He self-medicates his allergy symptoms with over-the-counter ephedrine for approximately 4 weeks before going to his physician. The vital signs were taken and the blood pressure is 160/92 and his pulse is 102. Which receptors were activated by ephedrine to produce these side effect?
    - A) α1
    - B) α2
    - C) β1
    - D) β2

- Ephedrine is a sympathomimetic drug that acts by stimulating both alpha and beta adrenergic receptors. In this case, the increased blood pressure and elevated heart rate observed in JN are likely due to the **activation of beta-1 (β1) adrenergic receptors.**

- **The reason for this is that ephedrine has a higher affinity for beta receptors compared to alpha receptors.** Stimulation of beta-1 receptors in the heart increases heart rate (positive chronotropic effect) and contractility, leading to an increase in cardiac output and subsequently blood pressure. This effect can explain the elevated pulse rate and blood pressure seen in JN after using ephedrine for his allergies.

Case 9

VG, 36 years of age, was diagnosed with angina pectoris. She has a history multiple allergies and asthma. The drug of choice for the treatment of her angina pectoris?

A) Propranolol

B) Timolol

C) Atenolol

D) Pindolol

- The drug of choice for the treatment of angina pectoris in a patient with multiple allergies and asthma would be Atenolol (Option C).

- **Therefore, the correct answer is:C) Atenolol**

- **Atenolol is a cardioselective beta-blocker that is commonly used in the management of angina pectoris.** It is preferred in patients with asthma and allergies because it has less effect on the beta-2 receptors in the lungs compared to non-selective beta-blockers like propranolol or timolol. Atenolol can help reduce the workload on the heart, decrease oxygen demand, and improve exercise tolerance in patients with angina.

Case 10

- SM is admitted for surgery. He has a history of heart disease, glaucoma, and benign prostatic hyperplasia (BPH). The drug used to control of the post operative nausea and vomiting will be?

  A) Scopolamine

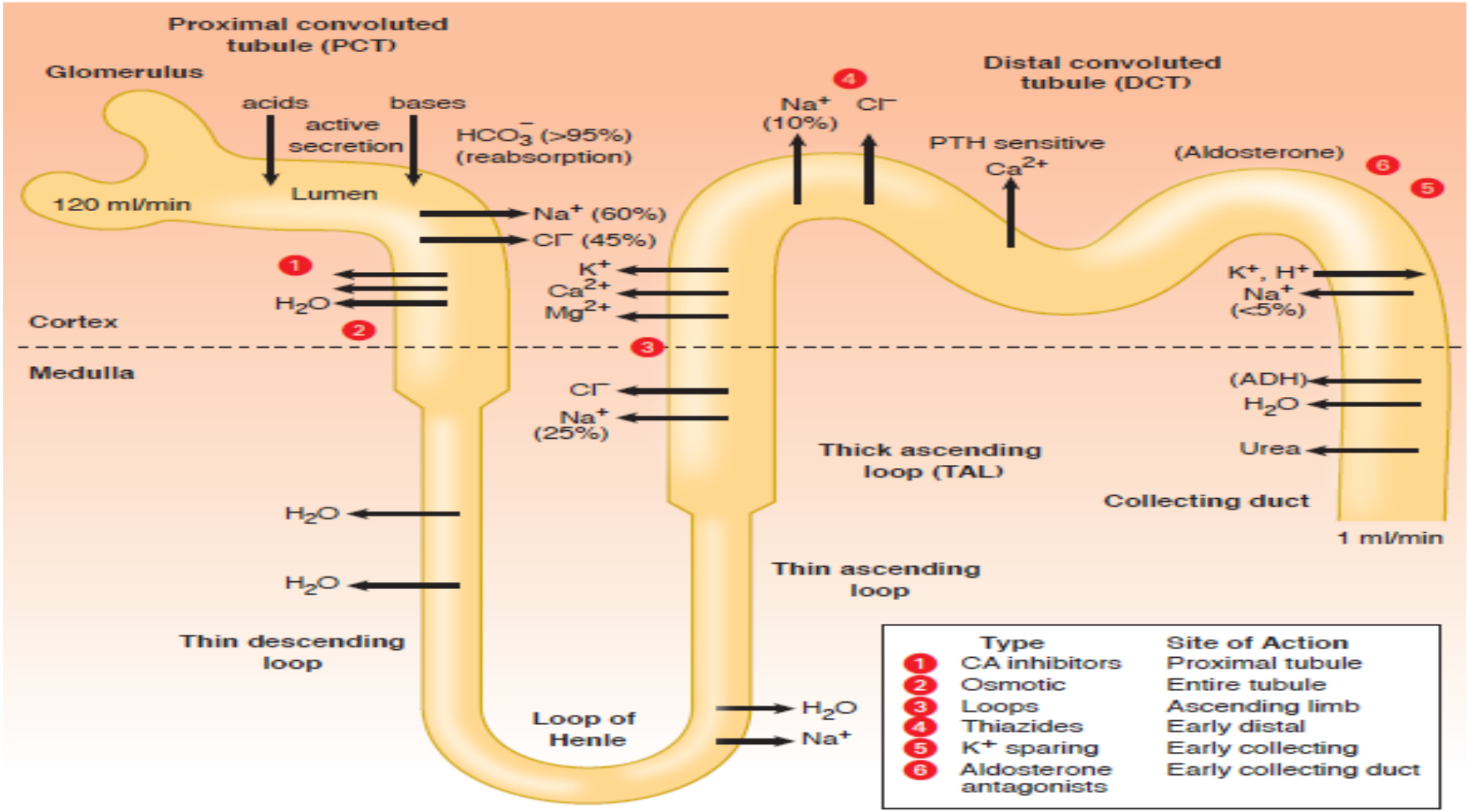
  B) Atropine

  C) Metoclopramide

  D) ondansetron

- The most appropriate drug for controlling postoperative nausea and vomiting in a patient with a history of heart disease, glaucoma, and benign prostatic hyperplasia (BPH) would be ondansetron (Option D).
- Therefore, the correct answer is: D) Ondansetron
- **Ondansetron is a serotonin 5-HT3 receptor antagonist commonly used for the prevention and treatment of nausea and vomiting, particularly in the postoperative setting.** It is generally well-tolerated and does not have significant anticholinergic effects that could exacerbate conditions like glaucoma or BPH. Ondansetron is also safe to use in patients with heart disease.

Cardiac and Renal Pharmacology



TYPES OF DIURETICS

- Osmotic Diuretics
  - Mannitol (IV) inhibits water reabsorption throughout the tubule.
  - It increases urine volume.
  - Uses:
    - ↓ IOP in glaucoma
    - ↓ intracerebral pressure
    - Oliguric states (e.g., rhabdomyolysis)
- Side effects: acute hypovolemia

Carbonic Anhydrase Inhibitors

- Drugs: **acetazolamide** and **dorzolamide**
- Mechanism: carbonic anhydrase inhibition, results in:
  - ↓ H+ formation inside PCT cell
  - ↓ Na+/H+ antiport
  - ↑ Na+ and HCO3
  - in lumen
  - ↑ diuresis

Uses:

  - Glaucoma
  - Acute mountain sickness
  - Metabolic alkalosis

- Side effects:
  - Bicarbonaturia and acidosis
  - Hypokalemia, Hyperchloremia
  - Renal stones, Sulfonamide hypersensitivity

Loop Diuretics

- Drugs: furosemide, torsemide, and ethacrynic acid
- Mechanism: Na+/K+/2Cl− transporter inhibition, results in:
  - ↓ intracellular K+ in TAL
  - ↓ back diffusion of K+
  - ↓ positive potential
  - ↓ reabsorption of Ca2+ and Mg2+
  - ↑ diuresis
- Uses:
  - Acute pulmonary edema
  - Heart failure
  - Hypertension
  - Refractory edemas
  - Hypercalcemic states

Side effects:

- Sulfonamide hypersensitivity (furosemide)
- Hypokalemia and alkalosis
- Hypocalcemia
- Hypomagnesemia
- Hyperuricemia (actively secreted by the OAT)
- Ototoxicity (ethacrynic acid > furosemide)

Thiazides

- Drugs: **hydrochlorothiazide**, **chlorthalidone**, and **indapamide**
- Mechanism: Na+/Cl− transporter inhibition, results in:
  - ↑ luminal Na+ and Cl− in DCT
  - ↑ diuresis

Uses:

- Hypertension, CHF
- Nephrolithiasis (calcium stones)
- Nephrogenic diabetes insipidus

Side effects:

- Sulfonamide hypersensitivity, Hypokalemia and alkalosis
- Hypercalcemia, Hyperuricemia (actively secreted by the OAT)
- Hyperglycemia, Hyperlipidemia (except indapamide)

K+-Sparing Diuretics

- **Drugs: Spironolactone: aldosterone-receptor antagonist**
- Uses: hyperaldosteronic state
  - adjunct to K+-wasting diuretics
  - antiandrogenic uses (female hirsutism)
  - congestive heart failure
- Side effects: hyperkalemia and acidosis; antiandrogen
- **Amiloride and triamterene:** Na+-channel blockers

Uses:

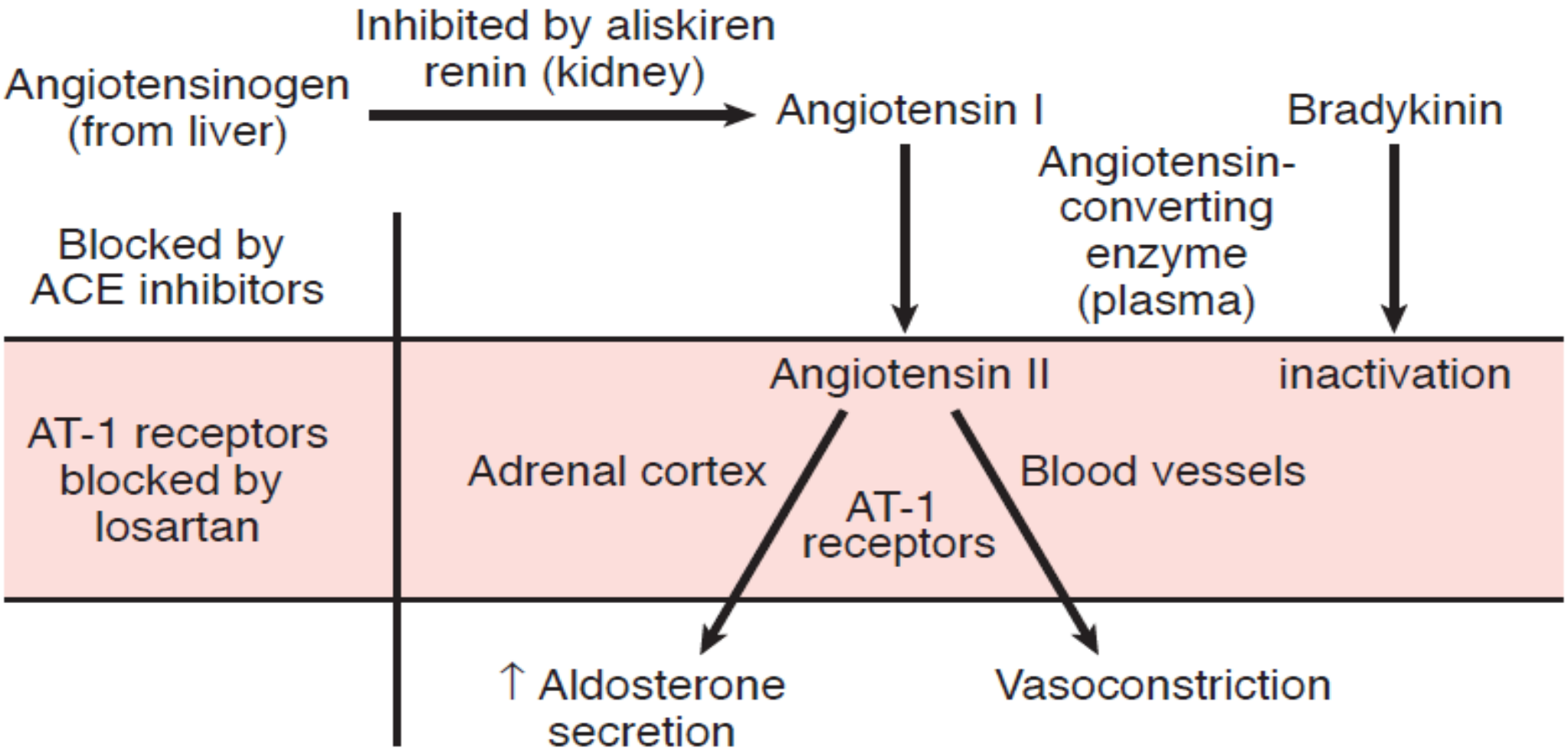
- adjunct to K+-wasting diuretics
- lithium-induced nephrogenic diabetes insipidus (amiloride)
- **Side effects: hyperkalemia and acidosis**

Drug	Mechanisms of Action	Urinary Electrolytes	Blood pH
Acetazolamide	Inhibition of carbonic anhydrase in PCT	↑ Na^+ ↑ K^+ ↑↑ HCO_3^-	Acidosis
Ethacrynic acid, furosemide, torsemide	Inhibition of $Na^+/K^+/2Cl^-$ cotransporter in TAL	↑↑ Na^+ ↑ K^+ ↑ Ca^{2+} ↑ Mg^{2+} ↑ Cl^-	Alkalosis
Hydrochlorothiazide, indapamide, chlorthalidone	Inhibition of Na^+/Cl^- cotransporter in DCT	↑ Na^+ ↑ K^+ ↑ Cl^- ↓ Ca^{2+}	Alkalosis
Amiloride, triamterene, spironolactone, eplerenone	Block Na^+ channels, block aldosterone receptors in collecting tubule	↑ Na^+ (small) ↓ K^+	Acidosis

Antihypertensives

- ↓ TPR
- ↓ CO
- ↓ body fluid volume
- ↓ BP may result in homeostatic regulation:
  - Reflex tachycardia (↑ sympathetic activity)
  - Edema (↑ renin activity)
- Drugs
- Thiazide diuretics are commonly used in the management of hypertension.
- Angiotensin-Converting Enzyme Inhibitors (ACEIs) and Angiotensin-Receptor Blockers (ARBs)

Drugs acting in the angiotensin System



Drugs acting in the angiotensin System……

ACEIs

- captopril, lisinopril (and other "–prils")
  - Block formation of angiotensin II
  - Resulting in prevention of AT1-receptor stimulation
  - ↓ aldosterone, vasodilation
  - ACEIs prevent bradykinin degradation

ARBs

- losartan (and other "–sartans")
  - Block AT1 receptors
  - Same results as ACEIs on BP mechanisms
  - ARBs do not interfere with bradykinin degradation

Renin inhibitor: aliskiren

- Blocks formation of angiotensin I
- Same results as ACEIs on BP mechanisms
- Aliskiren does not interfere with bradykinin degradation

Drugs acting in the angiotensin System…….

Uses:

- Mild-to-moderate hypertension (all)
- Protective of diabetic nephropathy (ACEI/ARBs)
- CHF (ACEI/ARBs)

Side effects:

- Dry cough (ACEIs)
- Hyperkalemia
- Acute renal failure in renal artery stenosis
- Angioedema

Contraindication: pregnancy

Calcium-Channel Blockers

- Calcium-channel blockers (CCBs) block L-type Ca2+ channels in heart and blood vessels.
  - Results in ↓ intracellular Ca2+
  - Causes ↓ CO (verapamil and diltiazem), ↓ TPR (all CCBs)
- Drugs: verapamil, diltiazem,
  - dihydropyridines (–“dipines,” prototype: nifedipine)
- **Uses:**
  - Hypertension (all drugs)
  - Angina (all drugs)
  - Antiarrhythmics (verapamil, diltiazem)
- **Side effects:**
  - Reflex tachycardia (“–dipines”)
  - Gingival hyperplasia (“–dipines”)
  - Constipation (verapamil)

Beta Blockers

- **Selective (Atenolol, metoprolol) and non selective (propranolol)**
- Side effects:
  - Cardiovascular depression
  - Fatigue
  - Sexual dysfunction
  - ↑ LDLs and TGs
- Cautions in use:
  - Asthma
  - Vasospastic disorders
  - Diabetics (alteration of glycemia and masking of tachycardia due to hypoglycemic events)

Alpha-1 Blockers(“zosins”)

- Drugs: prazosin, doxazosin, terazosin
- Decrease arteriolar and venous resistance
- Reflex tachycardia

Uses:

- Hypertension
- BPH: relax the smooth muscle of the prostate and bladder neck, which allows urine to flow more easily

Side effects:

- “first-dose” syncope; orthostatic hypotension; urinary incontinence
- Advantage: good effect on lipid profile (↑ HDL, ↓ LDL)

Alpha-2 Agonists

- **Drugs: clonidine and methyldopa (prodrug)**
- α2 stimulation: ↓ in sympathetic outflow; ↓ TPR but also ↓ HR
- **Uses:**
  - Mild-to-moderate hypertension (both)
  - Opiate withdrawal (clonidine)
  - Hypertensive management in pregnancy (methyldopa)
- **Side effects**
  - positive Coombs test (methyldopa); CNS depression (both); edema (both)
- **Drug interactions**
  - tricyclic antidepressants ↓ antihypertensive effects of α2 agonists

DIRECT-ACTING VASODILATORS

- Drugs Acting Through Nitric Oxide

Hydralazine

- ↓ TPR via arteriolar dilation
- Use: moderate-to-severe hypertension
- Side effects: SLE-like syndrome in slow acetylators; edema; reflex tachycardia

Nitroprusside

- TPR via dilation of both arterioles and venules
- Use: hypertensive emergencies (used IV)
- Side effects: cyanide toxicity

Drugs Acting to Open Potassium Channels

- **Drugs: minoxidil and diazoxide**
  - Open K+ channel, causing hyperpolarization of smooth muscle
  - Results in arteriolar vasodilation

Uses

- Insulinoma (diazoxide)
- Severe hypertension (minoxidil)
- Baldness (topical minoxidil)

Side effects

- Hypertrichosis (minoxidil)
- Hyperglycemia (↓ insulin release [diazoxide])
- Edema
- Reflex tachycardia

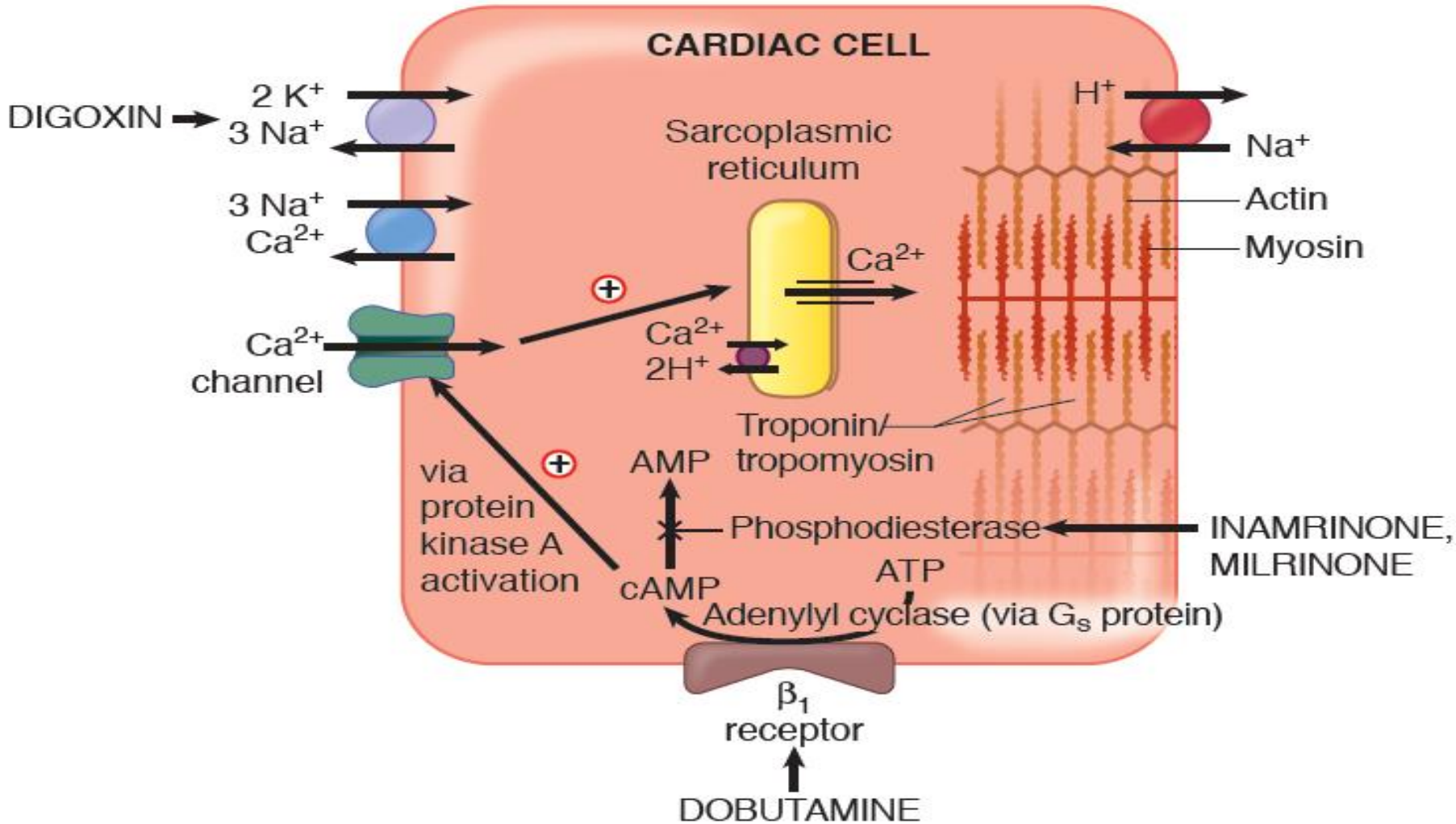
Use of Antihypertensive Drugs in Comorbid Conditions

Indication	Suitable Drug(s)
Angina	Beta blockers, CCBs
Diabetes	ACEIs, ARBs
Heart failure	ACEIs, ARBs, beta blockers
Post-MI	Beta blockers
BPH	Alpha blockers
Dyslipidemias	Alpha blockers, CCBs, ACEIs/ARBs
Chronic kidney disease	ACEI, ARBs

Drug treatment of CHF

- Pharmacotherapy aimed at:
  - ↓ preload: diuretics, ACEIs, ARBs, and venodilators
  - ↓ afterload: ACEIs, ARBs, and arteriodilators
  - ↑ contractility: digoxin, beta agonists, PDE III inhibitors
  - ↓ remodeling of cardiac muscle: ACEIs, ARBs, spironolactone, beta blockers
- Whereas digoxin does not improve survival, ACEIs, ARBs, beta blockers, and spironolactone have been proven beneficial in CHF.
- ACEIs and ARBs are currently drugs of choice for the chronic management of CHF.
- Inotropes are more beneficial in management of acute CHF.

Mechanism of action of ionotropes



Digoxin

- Direct effect: inhibition of cardiac Na+-K+ ATPase
  - Results in ↑ intracellular Na+
  - Decreases Na+/Ca2+ exchange
  - Increases intracellular Ca2+
  - Increases Ca2+ release from sarcoplasmic reticulum
  - Increases actin-myosin interaction
  - Increases contractile force
- Indirect effect: inhibition of neuronal Na+-K+ ATPase (results in ↑ vagal activity)

Pharmacokinetics:

- Renal clearance: caution in renal impairment
- Long t1/2: need loading dose (LD)
- Tissue protein binding (large Vd): displacement by other drugs (verapamil, quinidine)

Digoxin

Uses:

- CHF; supraventricular tachycardias, except Wolff-Parkinson-White syndrome
- Side effects:
- Early signs include anorexia, nausea, ECG changes
- Later signs include disorientation, visual effects (yellow-green color disturbances, blurry vision)
- In toxic doses, any cardiac arrhythmias
  - Management of toxicity: use of Fab antibodies toward digoxin
  - Supportive therapy (electrolytes)
  - antiarrhythmics class IB except quinidine, and verapamil

Other ionotropes

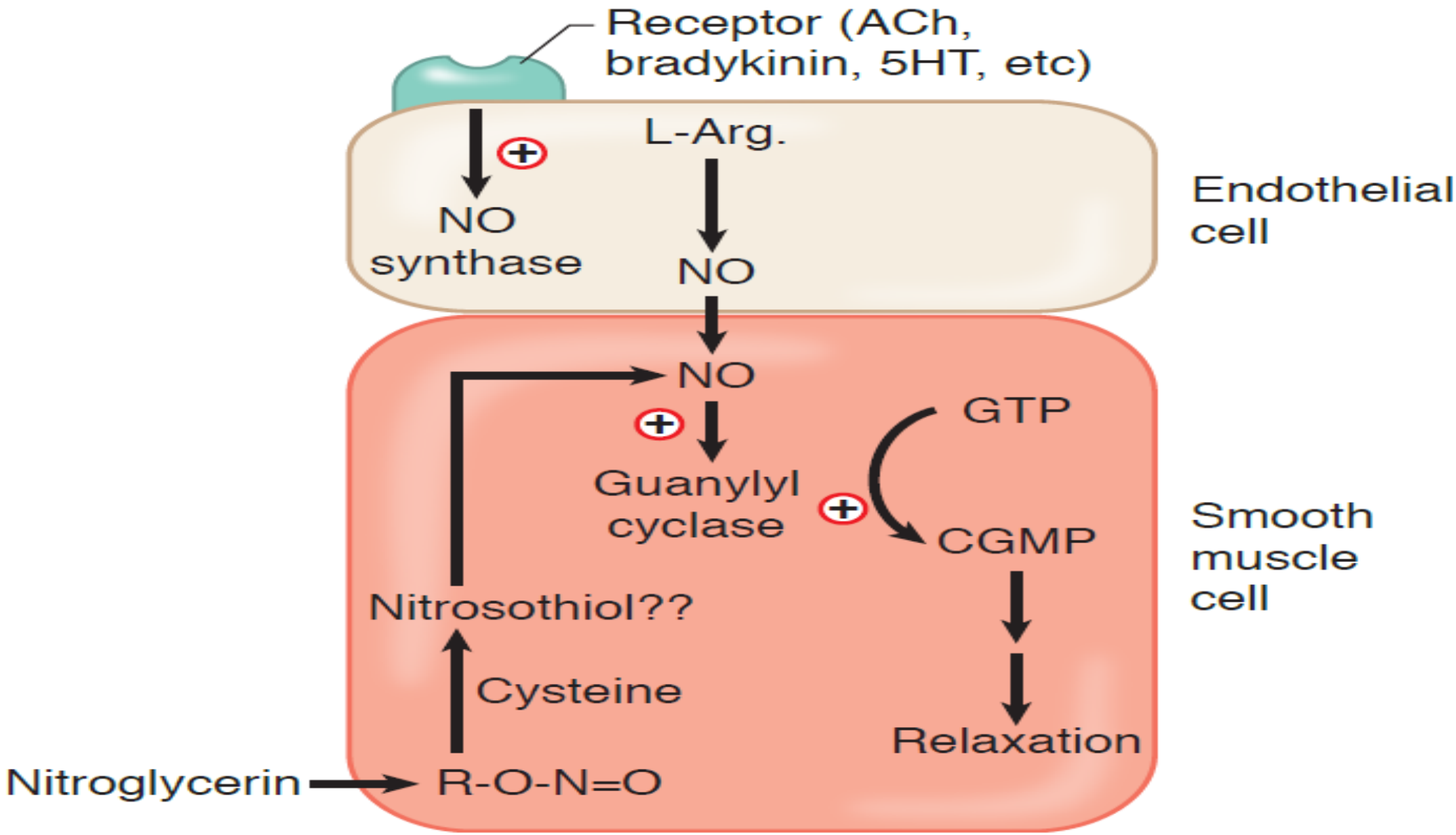
- **Phosphodiesterase Inhibitors: Inamrinone and Milrinone**
  - Use: acute CHF only
  - MOA: Increase cAMP in heart muscle; results in ↑ inotropy
  - Increase cAMP in smooth muscle; results in ↓ TPR
- Sympathomimetics: **Dobutamine and Dopamine**
  - Use: acute CHF only

TREATMENT OF CHF

- ACEI (ARB as an alternative)
- Beta blockers (**metoprolol, bisoprolol, carvedilol**)
  - Provide antiarrhythmic effect and also ↓ remodeling
- Diuretics
  - Loop or thiazide diuretics to decrease preload
  - Spironolactone or eplerenone to block aldosterone receptors and ↓
  - remodeling (used in advanced CHF)
- Hydralazine + isosorbide dinitrate
- Preferred for chronic therapy in patients who cannot tolerate
  - ACEI or ARB

Nitrates

- Nitrates are prodrugs of nitric oxide.
  - Venodilation →↓ preload →↓ cardiac work →↓ oxygen requirement
  - Nitrates ↓ infarct size and post-MI mortality
- **Drugs**
  - Nitroglycerin: sublingual, transdermal, and IV formulations
  - Isosorbide: oral, extended release for chronic use
- **Side effects:**
  - Flushing, headache, orthostatic hypotension
  - Reflex tachycardia and fluid retention
- **Cautions and contraindications:**
  - Tachyphylaxis with repeated use
  - Cardiovascular toxicity with sildenafil


Receptor (ACh, bradykinin, 5HT, etc)
L-Arg.
NO synthase
NO
Endothelial cell
NO
GTP
Guanylyl cyclase
CGMP
Smooth muscle cell
Nitrosothiol??
Cysteine
Relaxation
Nitroglycerin
R-O-N=O

Other drugs used in angina

- **Beta Blockers and Carvedilol**
  - Used in angina of effort
  - β-blockers are contraindicated in vasospastic angina
  - Carvedilol is clinically equivalent to isosorbide in angina of effort
- **Calcium Channel Blockers (CCBs)**
  - All CCBs can be used.
  - Nifedipine is important for vasospastic angina.

Case 11

A 75-year-old patient suffering from congestive heart failure accidentally ingests a toxic dose of digoxin. Clinical consequences due to the toxic effects of cardiac glycosides are likely to include

A. seizures

B. hypercalcemia

C. visual disturbances

D. intermittent claudication

- **Visual disturbances**
- Toxic effects of cardiac glycosides, such as digoxin, can lead to visual disturbances, including seeing halos around lights or blurred vision. Other symptoms of digoxin toxicity can include nausea, vomiting, confusion, and arrhythmias. Seizures are not a common symptom of digoxin toxicity. Hypercalcemia and intermittent claudication are not typically associated with digoxin toxicity.

Case 12

Which drug is useful for patients with congestive heart failure because it reduces both preload and afterload, and also inhibits cardiac remodeling?

A. Enalapril

B. Hydrochlorothiazide

C. Prazosin

D. Nifedipine

- **Enalapril**
- **Enalapril** is an angiotensin-converting enzyme (ACE) inhibitor that is commonly used in the treatment of congestive heart failure. It reduces both preload and afterload by inhibiting the conversion of angiotensin I to angiotensin II, leading to vasodilation and decreased fluid retention.
- Enalapril also inhibits cardiac remodeling by reducing the secretion of aldosterone and decreasing the production of collagen, which can help prevent further damage to the heart muscle.
- Hydrochlorothiazide is a diuretic that helps reduce fluid retention but does not have the same effects on cardiac remodeling. Prazosin is an alpha-1 adrenergic blocker that primarily reduces afterload but does not have the same impact on preload or cardiac remodeling. Nifedipine is a calcium channel blocker that primarily reduces afterload and does not have the same effects on preload or cardiac remodeling as enalapril.

Case 13

A new diuretic is being studied in human volunteers. Compared with placebo, the new drug increases urine volume, increases urinary $Ca^{2+,}$ increases plasma pH, and decreases serum K+. If this new drug has a similar mechanism of action to an established diuretic, it probably

A. blocks the NaCl cotransporter in the DCT

B. blocks aldosterone receptors in the CT

C. inhibits carbonic anhydrase in the PCT

D. inhibits the Na+/K+/2Cl– cotransporter in the TAL

Case 14

Which one of the following drugs is most likely to block K+ channels in the heart responsible for cardiac repolarization, and also blocks calcium channels in the AV node?

A. Amiodarone

B. Quinidine

C. Sotalol

D. Verapamil

➢Verapamil

- **Verapamil** is a calcium channel blocker that blocks calcium channels in the AV node, leading to decreased conduction velocity and slowing of the heart rate. Additionally, verapamil can also block potassium channels responsible for cardiac repolarization, prolonging the action potential duration. This dual mechanism of action can be beneficial in certain arrhythmias, as it can help stabilize the heart rate and rhythm.
- Amiodarone is a class III antiarrhythmic drug that primarily blocks potassium channels and has multiple other effects on sodium and calcium channels.
- Quinidine is a class Ia antiarrhythmic drug that blocks sodium channels.
- Sotalol is a non-selective beta-blocker with class III antiarrhythmic properties that primarily blocks potassium channels.

Case 15

Angiotensin converting enzyme inhibitors (ACEIs) have the side effect of dry cough due to preventing degradation of what substance?

A. Angiotensinogen

B. Angiotensin I

C. Bradykinin

D. Renin

Case 16

Which of the following drugs is associated with an SLE-like syndrome?

A. Captopril
B. Lidocaine
C. Procainamide
D. Quinidine

Case 17

A patient who is taking warfarin experienced presence of gross hematuria and large areas of bruising on the patient's body. As a pharmacist which medication should be prescribed for this patient?

A. Heparin sulfate

B. Protamine sulfate

C. Phytonadione (Vitamin K)

D. Oral potassium supplements

Case 18

A patient in the clinic reports difficulty tolerating the current ACE inhibitor medication, and questions if another medication could be used. Which medication will you choose, which affects the renin-angiotensin-aldosterone system?

a. Atenolol

b. Losartan

c. Spironolactone

d. Adenosine

Case 18

A woman who has a mechanical heart valve and who is taking warfarin informs you that she hopes to get pregnant in the near future. What advice should she receive regarding her antithrombotic medication during the anticipated pregnancy?

A. Warfarin should be continued until the third trimester.

B. Warfarin should be replaced with aspirin at analgesic doses.

C. Warfarin should be replaced with heparin.

D. Warfarin should be discontinued, and supplementary vitamin K taken throughout the pregnancy.

Case 19

A 25 year old lady was using oral contraceptives successfully for last two years. She got tuberculosis and was prescribed Rifampicin. She became pregnant after 2 months of starting Rifampicin despite continuing the oral contraceptives. How do you explain to her for the pregnancy despite taking oral contraceptive?

A. Induction of oral contraceptive metabolism

B. first pass effect of oral contraceptive

C. Interruption of entero-hepatic circulation

D. Increased excretion of oral contraceptives

Case 20

A 65-year-old man with congestive heart failure presented to the clinic complaining of several days of fatigue and fast heart rate. On physical examination, his pulse was irregular, and his heart rate was 130 bpm. After doing an electrocardiogram, a diagnosis of atrial fibrillation was made, and cardioversion was planned for this patient in 6 weeks. Which of the following drugs did the patient most likely receive during the 6 weeks before cardioversion?

A. Heparin

B. Streptokinase

C. High-dose aspirin

D. Warfarin

Case 21

- A 65-year-old man leaving the hospital after a myocardial infarction received an appropriate post discharge therapy that included aspirin, one low-dose tablet daily. Which of the following act ions most likely mediated the therapeutic effect of the drug in the patient's disease?
  - A. Competitive inhibition of cyclooxygenase
  - B. Competitive inhibition of lipoxygenase
  - C. Irreversible blockade of adenosine diphosphate (ADP) receptors
  - D. Activation of the glycoprotein IIb/IIIa receptor complex

Case 22

A 66-year-old woman suffering from systolic cardiac failure was brought to the emergency department because of a sudden onset of extreme dyspnea. She presented with cyanosis, tachypnea, hyperpnea, restlessness, anxiety, and a sense of suffocation. Cough was prominent and produced frothy sputum. Pulse was fast (120 bpm), blood pressure 80/45 mm Hg, and rales were audible at the lung bases. Which of the following drugs was most likely included in the immediate medical treatment of this patient?

A. Hydrochlorothiazide

B. Amiloride

C. Mannitol

D. Epinephrine

E. Furosemide

Case 23

A 63-year-old woman was brought to the emergency department because she had become more lethargic and unresponsive over the past several days. Her past medical history was significant for bone metastases from breast cancer. Physical examination revealed a dehydrated, cachectic female responsive only to painful stimuli. Pertinent serum values were Na+ 148 mEq/L (136−145 mEq/L); Ca 19.2 mg/dL (8.5−10.5 mg/dL). An intravenous saline infusion was started, and a diuretic was given concurrently. Which of the following diuretics was most likely administered?

A. Acetazolamide

B. Hydrochlorothiazide

C. Furosemide

D. Amiloride

E. Spironolactone

Case 24

A 64-year-old woman suffering from stage C heart failure had her diuretic medication changed because of a serious allergic reaction to furosemide. Which of the following diuretics was most likely prescribed?

A. Spironolactone

B. Acetazolamide

C. Mannitol

D. Ethacrynic acid

E. Triamterene

Case 25

A 60-year-old man was admit ted to the hospital because of symptoms of episodic weakness, polydipsia, and polyuria over the past 2 weeks. Vital signs on admission were blood pressure 136/95 mm Hg; heart rate 80 bpm; respirations 13/min. Significant serum results on admission were K+ 3.1 mEq/L (normal 3.5−5.0 mEq/L); aldosterone 45 ng/dL (normal 7−30 ng/dL). A computed tomography scan showed bilateral adrenal hyperplasia. Which of the following drugs was most likely included in the therapeutic regimen of this patient?

A. Hydrochlorothiazide
B. Mannitol
C. Furosemide
D. Nitroprusside
E. Spironolactone

Case 26

A 65-year-old patient was scheduled for surgery to remove a glioma located on his left parietal lobe. Which of the following drugs would be most appropriately given before and after surgery to prevent increased intracranial pressure?

A. Mannitol

B. Hydrochlorothiazide

C. Triamterene

D. Verapamil

E. Propranolol

Case 27

30. A 63-year-old man was admit ted to the emergency department because of a 12-hour history of dyspnea and bradycardia. He was taking propranolol, captopril, furosemide, and amiloride because of a previous myocardial infarction, as well as ibuprofen for osteoarthritis. Physical examination showed the patient was in respiratory distress with the following vital signs: blood pressure 150/86 mm Hg; heart rate 40 bpm; respirations 20/min. A lab analysis was ordered. Which of the following substances was most likely increased in the patient's serum?

A. Sodium
B. Calcium
C. Glucose
D. Potassium
E. Urea nitrogen

Case 28

A 69-year-old man was recently diagnosed with severe cardiac failure, and the physician started treatment with propranolol, captopril, and digoxin. Diuretic therapy was also included. Which of the following pairs of diuretics would have been most appropriate for this patient?

A. Hydrochlorothiazide and acetazolamide

B. Furosemide and spironolactone

C. Triamterene and acetazolamide

D. Hydrochlorothiazide and mannitol

E. Furosemide and mannitol

Case 29

A 57-year-old Black woman, recently diagnosed with closed angle glaucoma, was scheduled for iridotomy. Which of the following agents was most likely given intravenously before and after surgery to reduce intraocular pressure?

A. Furosemide

B. Triamterene

C. Mannitol

D. Hydrochlorothiazide

E. Phenylephrine

Case 30

A 32-year-old woman suffering from idiopathic hypercalciuria was diagnosed with a large urinary stone in the right renal pelvis. She was scheduled for surgical removal of the calculus. Which of the following drugs would be appropriate for this patient to prevent new stone production after the operation?

A. Acetazolamide

B. Hydrochlorothiazide

C. Furosemide

D. Triamterene

E. Spironolactone

Case 31

A 68-year-old man recently diagnosed with stage C heart failure started a treatment with metoprolol, losartan, furosemide, and digoxin. Which of the following molecular actions most likely mediated the positive inotropic action of digoxin?

A. Closing of calcium channels in cardiac cell membranes

B. Increased release of Ca^{2+} from the sarcoplasmic reticulum during systole

C. **Activation of Na+/K+ ATPase**

D. Activation of the Ca2+/Na+ exchanger in cardiac cell membranes

E. Opening of K+ channels in cardiac cell membranes

CNS pharmacology

Drugs used in depression

- Selective Serotonin Reuptake Inhibitors (SSRIs)
- Drugs: fluoxetine, paroxetine, sertraline, citalopram, fluvoxamine
- Mechanism: selective blockade of 5HT reuptake
- Uses:
  - Major depression
  - OCD
  - Bulimia nervosa
  - Anxiety disorders (chronic treatment/acute, benzodiazepines)
  - Premenstrual dysphoric disorder (PMDD)
- Side effects: anxiety, agitation, sexual dysfunction, weight loss
- Toxicity: serotonin syndrome

Tricyclic Antidepressants (TCAs)

- Drugs: amitriptyline, imipramine, and clomipramine
- Mechanism: nonspecific blockade of 5HT and NE reuptake
- Uses:
  - Major depressions
  - Phobic and panic anxiety states
  - Obsessive-compulsive disorders (OCDs)
  - Neuropathic pain
  - Enuresis
- Side effects: muscarinic and α blockade
- Toxicity: the “3 Cs”: coma, convulsions, and cardiotoxicity

Serotonin and Norepinephrine Reuptake Inhibitors (SNRIs)

- Drugs: venlafaxine, desvenlafaxine, duloxetine
- Mechanism: inhibit re-uptake of both serotonin and NE
- Uses: similar to SSRIs
- Side effects: anorexia, somnolence, increased blood pressure, inappropriate antidiuretic hormone secretion (SIADH); hepatotoxicity (duloxetine)
- Toxicity: serotonin syndrome (increased 5-HT interaction with MAOIs, TCAs, and meperidine)

MAO Inhibitors

- Drugs: phenelzine and tranylcypromine
- Mechanism: irreversible inhibition of MAOA and MAOB
- Use: atypical depressions
- Drug interactions
  - Serotonin syndrome: SSRIs, TCAs, and meperidine
  - ↑ NE: hypertensive crisis
    - Symptoms: ↑ BP, arrhythmias, excitation, hyperthermia
    - Drugs: releasers (i.e., tyramine), tricyclic antidepressants (TCAs), α1 agonists, levodopa
- Drug food interaction
  - With tyramine containing foods like cheese, fish, ripen banana,

Other Antidepressants

- Trazodone: associated with cardiac arrhythmias and priapism
- Bupropion: dopamine and norepinephrine reuptake blocker; fewer sexual side effects; used in smoking cessation
- Mirtazapine: $\alpha 2$ antagonist, associated with weight gain

DRUGS USED IN BIPOLAR DISORDERS

Lithium

- Lithium remains DOC for bipolar disorders. Antidepressants/antipsychotics are also usually required.
- Mechanism:
  - Prevents recycling of inositol (↓ PIP2) by blocking inositol monophosphatase.
  - ↓ cAMP
- Side effects:
  - Narrow therapeutic index; requires therapeutic monitoring
  - Tremor, flu-like symptoms, life-threatening seizures
  - Hypothyroidism with goiter
  - Nephrogenic diabetes insipidus
  - Teratogenicity
- Other drugs used in bipolar disorders include valproic acid and carbamazepine.

DRUGS USED IN PARKINSON DISEASE

- Signs and symptoms of Parkinson disease include bradykinesia, muscle rigidity, and resting tremor.
- The pathology of Parkinson involves the degeneration of nigrostriatal dopamine tracts with imbalance between dopamine (decreased) and ACh (increased).
- The pharmacologic strategy for Parkinson disease is to restore normal dopamine and decrease ACh activity at muscarinic receptors in the striatum.

Drugs Increasing Dopamine Function

- **Levodopa**
  - Prodrug converted to dopamine by aromatic amino acid decarboxylase (AAAD)
  - Given with carbidopa
  - Side effects: dyskinesias, “on-off” effects, psychosis, hypotension, vomiting
- Dopamine-Receptor Agonists
  - Pramipexole and ropinirole, Bromocriptine
  - Use: hyperprolactinemia and acromegaly
  - Side effects: dyskinesias and psychosis

Drugs Increasing Dopamine Function……

- **Tolcapone and entacapone**
  - COMT converts L-dopa to 3-O-methyldopa, a partial agonist at dopamine receptors.
  - These drugs inhibit COMT and enhance levodopa uptake and efficacy.
  - Tolcapone is hepatotoxic.
- **Selegiline**
  - MAOB-selective inhibitor (no tyramine interactions)
  - Initial treatment and adjunct to levodopa
  - Side effects: dyskinesias, psychosis, insomnia (metabolized to amphetamine)

Drugs Decreasing ACh Function

- Benztropine and trihexyphenidyl
  - muscarinic blockers
  - Actions: ↓ tremor and rigidity but have little effects on bradykinesia
  - Side effects: atropine-like
- Amantadine
  - Antiviral, which block muscarinic receptors and ↑ dopamine release
  - Side effects: atropine-like and livedo reticularis

ANTIPSYCHOTIC DRUGS

- Schizophrenia
  - Positive symptoms of schizophrenia include thought disorders, delusions, hallucinations, and paranoia.
  - Negative symptoms include amotivation, social withdrawal, flat affect, and poverty of speech.
- The “dopamine hypothesis” of schizophrenia states that symptoms arise because of excessive dopaminergic activity in mesolimbic system.
  - Dopamine agonists cause psychosis.
  - Dopamine antagonists have antipsychotic actions.
- Recently, Serotonin is increasingly seen as a part of the etiology of schizophrenia.
- Mechanisms
  - Blockade of dopamine receptors(Typical)
  - Blockade of 5HT2 receptors(Atypicals)
- Uses
  - Schizophrenia
  - Schizoaffective states
  - Bipolar disorder
  - Drug or radiation emesis

- Side Effects
  - From dopamine blockade
    - Dyskinesias (extrapyramidal symptoms [EPS])
      - Acute EPS: pseudoparkinsonism, dystonia, akathisia (management: antimuscarinic drugs [benztropine or diphenhydramine])
      - Chronic EPS: tardive dyskinesia (TD) (management: discontinuation/switch to atypical)
    - Increased prolactin (galactorrhea, amenorrhea, gynecomastia)
  - From muscarinic blockade (particularly tachycardia and decreased seizure threshold)
  - From alpha blockade (particularly hypotension)

Drug Group Examples	EPS*	M Block	Sedation	Alpha Block	Other Characteristics
Typicals					
Chlorpromazine	++	++	+++	+++	NA
Thioridazine	+	+++	+++	+++	• Cardiotoxicity (torsades—"quinidine-like") • Retinal deposits
Fluphenazine	+++	+	+	+	NA
Haloperidol	+++	+	+	+	Most likely cause of neuroleptic malignant syndrome (NMS) and TD
Atypicals					
Clozapine	+/−	++	+	+++	• Blocks D_{2c} and $5HT_2$ receptors • No TD • Agranulocytosis—(weekly WBC count) requirement for weekly blood test, weight gain • Increased salivation ("wet pillow"syndrome) • Seizures
Olanzapine	+/−	+	+	++	Blocks $5HT_2$ receptors, improves negative-symptoms
Risperidone	+	+/−	++	++	Blocks $5HT_2$ receptors, improves negative symptoms, increased prolactin
Aripiprazole	+	+/−	+/−	+/−	Partial agonist of D_2 receptor; blocks $5HT_2$ receptors
Other atypicals: quetiapine, ziprasidone					

* Extrapyramidal symptoms

Anticonvulsants

DRUGS USED IN SEIZURES

- Seizures result from episodic electrical discharges in cerebral neurons associated with prolonged depolarization, during which sustained, high-frequency, repetitive firing occurs, followed by prolonged hyperpolarization.

Seizure Type	Effective Drugs
Partial—simple or complex	Valproic acid, phenytoin, carbamazepine, lamotrigine
General—tonic-clonic	Valproic acid, phenytoin, carbamazepine, lamotrigine
General—absence	Ethosuximide, valproic acid
Status epilepticus	Lorazepam, diazepam, phenytoin, or fosphenytoin*

Mechanisms of Action

- preventing Na+ influx : carbamazepine, phenytoin
- Increased inhibitory action of GABA-mediated hyperpolarization: barbiturates, benzodiazepines
- Decreased excitatory effects of glutamic acid: lamotrigine, topiramate, felbamate
- Decreased T-type Ca^{2+} channels: ethosuximide and valproic acid

Phenytoin

- Induction of cytochrome P450s
- Zero-order kinetic of elimination
- Side effects:
  - CNS depression
  - Gingival hyperplasia
  - Hirsutism
  - Osteomalacia (↓ vitamin D)
  - Megaloblastic anemia (↓ folate)
  - Aplastic anemia (check hematology lab results)
- Teratogenicity: cleft lip and palate

Carbamazepine

- Additional uses
  - DOC for trigeminal neuralgia
  - Bipolar disorder
- induces cytochrome P450, including its own metabolism
- Side effects:
  - CNS depression
  - Osteomalacia
  - Megaloblastic anemia
  - Aplastic anemia
  - Exfoliative dermatitis
  - ↑ ADH secretion (dilutional hyponatremia)
- Teratogenicity: cleft lip and palate; spina bifida

Valproic acid

- Mechanism:
  - Similar to phenytoin
  - But also inhibition of GABA transaminase
  - Blockade of T-type Ca2+ channels
- Uses:
  - All types of Seizure
  - Mania of bipolar disorders
  - Migraine prophylaxis
- inhibits cytochrome P450s
- Side effects:
  - Hepatotoxicity (from toxic metabolite)
  - Thrombocytopenia
  - Pancreatitis
  - Alopecia
- Teratogenicity: spina bifida

Ethosuximide

- Mechanism: blockade of T-type Ca2+ channels in thalamic neurons
- Use: absence seizures
- General features of anticonvulsant drug use include:
  - Anticonvulsants are additive with other CNS depressants
  - Avoid abrupt withdrawal, which may precipitate seizures
  - ↓ efficacy of oral contraceptives via induction of cytochrome P450

Case 32

A 40-year-old man was given a drug that binds to a subunit of the GABAA receptor. When used at a high dose, the drug can open Cl^- channels independent of GABA. What drug was the man given?

A. Diazepam

B. Ethanol

C. Phenobarbital

D. Baclofen

Case 33

Which one of the following is characteristic of both phenytoin and carbamazepine?

A. **Induction of hepatic cytochrome P450**

B. First-order elimination at high therapeutic doses

C. Enhances the effects of oral contraceptives

D. Prevent sodium influx through activated sodium channels

Case 34

A 45 year old women was diagnosed with a bipolar disorder with manic episode. She come to your pharmacy with a lithium prescription. Which one of the following accurate information you will provide to her?

A. lithium causes symptoms of mild hyperthyroidism in up to 25% of patients

B. Spina bifida is major concern in fetal development

C. Adverse effects include acne, polydipsia, and polyuria

D. the manic symptoms will be calmed by sedative effect of lithium within

Case 35

A 54 years old men was unable to move his hands and legs. He also start to forget the name of his children. He was diagnosed with Parkinson's disease with symptoms of bradykinesia, postural instability, and tremor. He started treatment with a combination of levodopa and carbidopa. What Is the rationale for combining levodopa with carbidopa?

A. Carbidopa stimulates dopamine receptors

B. Carbidopa inhibits peripheral dopa decarboxylase

C. Carbidopa enhances levodopa absorption

D. Carbidopa blocks peripheral COMT

Case 36

A 29-year-old man is being treated with an antidepressant drug, and his mood is improving. However, he complains of feeling of agitated at times, and if he takes his medication in the afternoon he finds it difficult to get to sleep at night. He seems to have lost weight during the 6 months that he has been taking the drug. He has been warned not to take other drugs without consultation because severe reactions have occurred with opioid analgesics including meperidine. This patient is probably taking

A. alprazolam

B. paroxetine

C. amitriptyline

D. trazodone

Case 37

A patient suffering from generalized anxiety disorder (GAD) has a history of drug dependence that includes the illicit use of secobarbital (“reds”) and a variety of other drugs. Psychotherapy is indicated, but the physician also prescribes a drug that can be helpful in GAD and that has the advantage of no abuse liability. The drug prescribed was most likely to have been

A. bupropion
B. buspirone
C. Alprazolam
D. Morphine
E. Phenobarbital

Case 38

A 45 years old patient has been diagnosed for postherpetic neuralgia.he has also a long QT syndrome. What would be an appropriate drug for his pain?

A. Amitriptyline

B. Fentanyl

C. Acyclovir

D. Gabapentin

Case 39

A person who is a habitual user of a schedule-controlled drug abruptly stops using it. Within 8 h, she becomes anxious, starts to sweat, and gets severe abdominal pain with diarrhea. These symptoms intensify over the next 12 h, during which time she has a runny nose, is lacrimating, and has uncontrollable yawning and intensification of muscle cramping and jerking. Assuming that these are withdrawal symptoms in the patient due to her physical dependence to opioid analgesics. The most appropriate drug for the treatment of this patient is

A. Flumazenil
B. Naloxone
C. Bupropion
D. Amphetamine

Case 40

A 57-year-old patient, living at home, has severe pain due to a metastatic carcinoma that is being managed with fentanyl. As a pharmacist, which of the following drugs would recommend for the patient to take home to prevent the side effect of fentanyl

A. naloxone

B. docusate

C. loperamide

D. morphine

Case 41

A hospital nurse is taking imipramine for a phobic anxiety disorder, and her patient is being treated with chlorpromazine for a psychotic disorder. Which of the following adverse effects is likely to occur in both of these individuals?

A. Excessive salivation

B. Pupillary constriction

C. Orthostatic hypotension

D. Increase Seizure threshold

E. Weight loss

Case 42

A 30-year-old man is brought to the ER with the following symptoms attributed to a drug overdose: HR and BP, mydriasis, behavioral excitation, aggressiveness, paranoia, and hallucinations. Of the following drugs, which one is most likely to be responsible for these symptoms?

A. Amphetamine

B. Ethanol

C. Fentanyl

D. Marijuana

Case 43

A 28-year-old man was brough t to the emergency department because of a generalized tonic-clonic seizure. History showed that the man had been suffering from epilepsy since childhood, but the seizures were only partially controlled by medication. Which of the following pairs of neurotransmitters are thought to be mainly involved in seizure disorders?

A. GABA and serotonin

B. GABA and acetylcholine

C. Serotonin and glutamate

D. GABA and glutamate

Case 44

A 37-year-old woman was at a routine neurology clinic visit. The woman had a long history of refractory grand mal epilepsy. She was being treated with several drugs, but with poor results. The neurologist decided to prescribe phenytoin. Blockade of which of the following types of ion channels is most likely to mediate the therapeutic efficacy of the drug in the patient's disease?

A. Na+ channels in the resting state

B. Na+ channels that open and close at high frequency

C. Na+ channels that open and close at low frequency

D. K+ channels in a resting state

Case 45

A 32-year-old woman complained to her physician that two breakthrough seizures occurred last week. One month earlier the woman was diagnosed with simple partial seizure and started treatment with an antiepileptic drug. The physician increased the dose of the drug, thinking that the decreased effect was most likely because the drug is a potent enzyme inducer and can induce it s own metabolism. Which of the following drugs did the patient most likely take?

A. Valproic acid

B. Carbamazepine

C. Lamotrigine

D. Ethosuximide

Case 46

A 47-year-old woman complained to her physician of blurred and double vision. She had been suffering from a CNS disorder and had been receiving a drug treatment for 6 months. Physical examination showed mild hirsutism, broadening of her lips and nose, and thickening and bleeding of her gums. Which of the following drugs most likely caused these adverse effects?

A. Diazepam

B. Valproic acid

C. Gabapentin

D. Phenytoin

Case 47

A 26-year-old woman discovered she was unexpectedly pregnant. She had been regularly taking an oral contraceptive medication for several years. Two months earlier, she was diagnosed with complex partial seizures and started the prescribed therapy. Which of the following drugs was she most likely taking?

A. Lamotrigine

B. Valproic acid

C. Carbamazepine

D. Gabapentin

Case 48

A 45-year-old woman complain ed of blurred vision , dry mouth, palpitations, and constipation. The patient was diagnosed with Parkinson disease 4 months earlier and had been receiving a levodopa/carbidopa combination since then. Recently, her neurologist added a drug to the therapeutic regimen because of an increase in the patient's resting tremor. Which of the following drugs most likely caused the patient's symptoms?

A. Pramipexole

B. Selegiline

C. Amantadine

D. Benztropine

Case 49

A 28-year-old man found wandering half-dressed in the streets complained of hearing voices cursing him, and his reported thoughts were bizarre. Upon admission to the psychiatric ward, his behavior became disruptive. He refused to cooperate and started verbal assaults that included threats of physical violence. A therapy was planned that include the intravenous injection of a drug. Which of the following drugs was most likely administered?

A. Lithium
B. Imipramine
C. Risperidone
D. Fluoxetine
E. Morphine

Case 50

- A 43-year-old man went to his physician complaining of difficulty in maintaining an erection during intercourse. Past history of the patient was significant for an episode of ventricular tachycardia 1 year earlier. He was recently diagnosed with major depressive disorder and started a drug treatment 2 weeks ago. Which of the following drugs most likely caused the symptom reported by the patient?
  - A. Lithium
  - B. Amitriptyline
  - C. Fluoxetine
  - D. Chlorpromazine
  - E. Bupropion